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Twist Drill Dynamometer

Mechanical Engineering

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TWIST DRILL DYNAMOMETER

BY

THEODORE JAMES SCHANCE

THESIS

FOR THE

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TWIST DRILL DYNAMOMETER.

The introduction of the high speed twist drill into modern machine shop practice has brought with it many problems upon whose correct solution we are dependent for data regarding conditions under which they may be operated with maximum efficiency and longest life. Up to the present time but very little reliable information has been available, either because experiments have not been carried to completion or because the data obtained has been presented in such a form that it could not be turned to practical account. It is to supply such data in the most available form for practical use that the machine which is the subject of this paper has been designed and built.

1. End In View In Design Of Apparatus. In conducting experiments along this line two variables must be taken into consideration, - the torque, or twisting moment, and the downward thrust exerted upon the drill. It has been shown by previous experiments that these are dependent upon three things, - the feed, speed and angle with which the drill is sharpened. Since these three can be regulated and kept constant throughout a test, the problem is, therefore, to design a machine of the simplest possible construction from which the torque and thrust may be read in foot pounds and pounds respectively.

2. Description Of Machine. The machine is really a double dynamometer, each part acting independent of the other, the relative positions being better shown by the sketch than they can be described. The dynamometer consists prim arily of two oil reservoirs, or compression chambers, through which the pressure may be communicated to pressure gauges, or manometers. The downward thrust is taken from the horizontal and largest reservoir, which is bolted to the table of the drill press. Resting on the surface of the oil and fastened to the walls of this reservoir to produce an air tight chamber is a rubber diaphragm, a metal disc slightly smaller than the inner diameter of the reservoir being supported by the

diaphragm. Upon this disc and between it and the hub on which the work is clamp- is a large end-thrust ball bearing. This leaves the work free to rotate in the direction of motion of the drill, while the lower disc remains stationary and transmits the downward pressure to the oil. The bearing was selected after a careful consideration of the various types of this class of bearings, special attention being paid to automatic alignment and simplicity of the parts. It is of special German manufacture and should give, with proper attention, almost frictionless rotation. Projecting out from the upper part is a rigid radial arm which transmits the torque from the hub to a small disc resting on the smaller diaphragm. The second reservoir is supported, with this diaphragm in a vertical position, by a bracket extending upwards from the base of the apparatus. The pressure necessary to prevent rotation of the arm is transmitted by means of this disc through the diaphragm to the oil and hence to the pressure gauge, or manometer connected to this reservoir.

3. Construction. With the exception of the bearing the machine is constructed of cast iron, all parts being finished except the base and large reservoir. This reservoir was turned on a boring mill to an inside diameter of 11-21/32 inches and is 4 inches deep, having a capacity of about one gallon. The small reservoir was finished all over in a lathe, the inside diameter being 4-11/16 inches with a depth of 1-5/8 inches, holding about one pint of oil. The ball race is made of hardened steel, being ground after hardening to insure accuracy.

4. Gauges And Calibration. The size and type of gauge, or manometer, to be used depends entirely upon the conditions of the test. With large drills a low pressure gauge for torque and a high pressure gauge to register the downward pressure should give the best results. With smaller drills, say 5/8 inch and smaller, a low pressure gauge should be used in connection with each reservoir. Where extreme accuracy and sensitiveness is desired, a manometer of small bore

would probably give the best results.

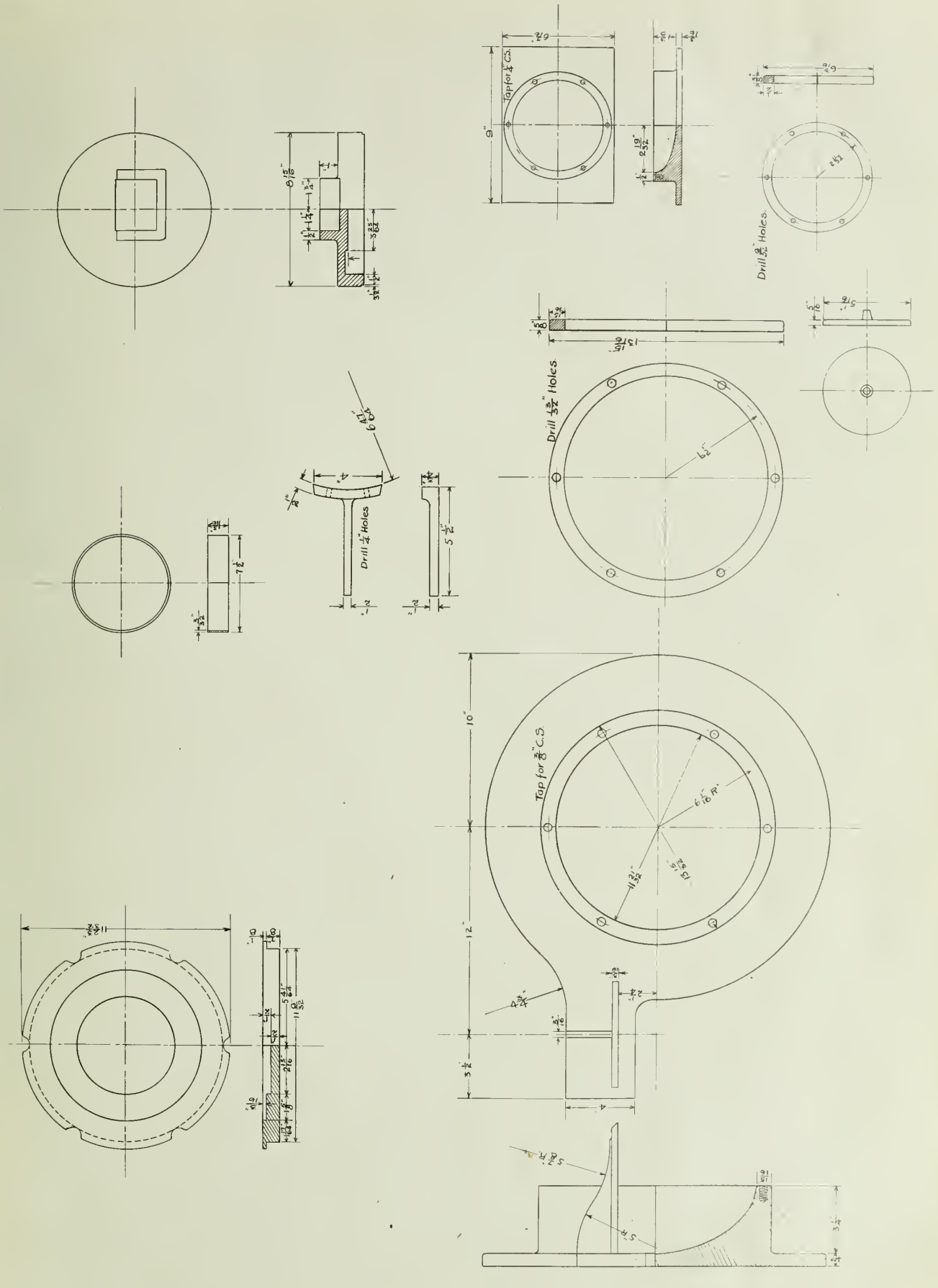
The accuracy of the machine depends largely upon its proper calibration. This may easily be accomplished by placing the complete apparatus in a Riehle testing machine, and calibrating each part as though it were a separate apparatus.

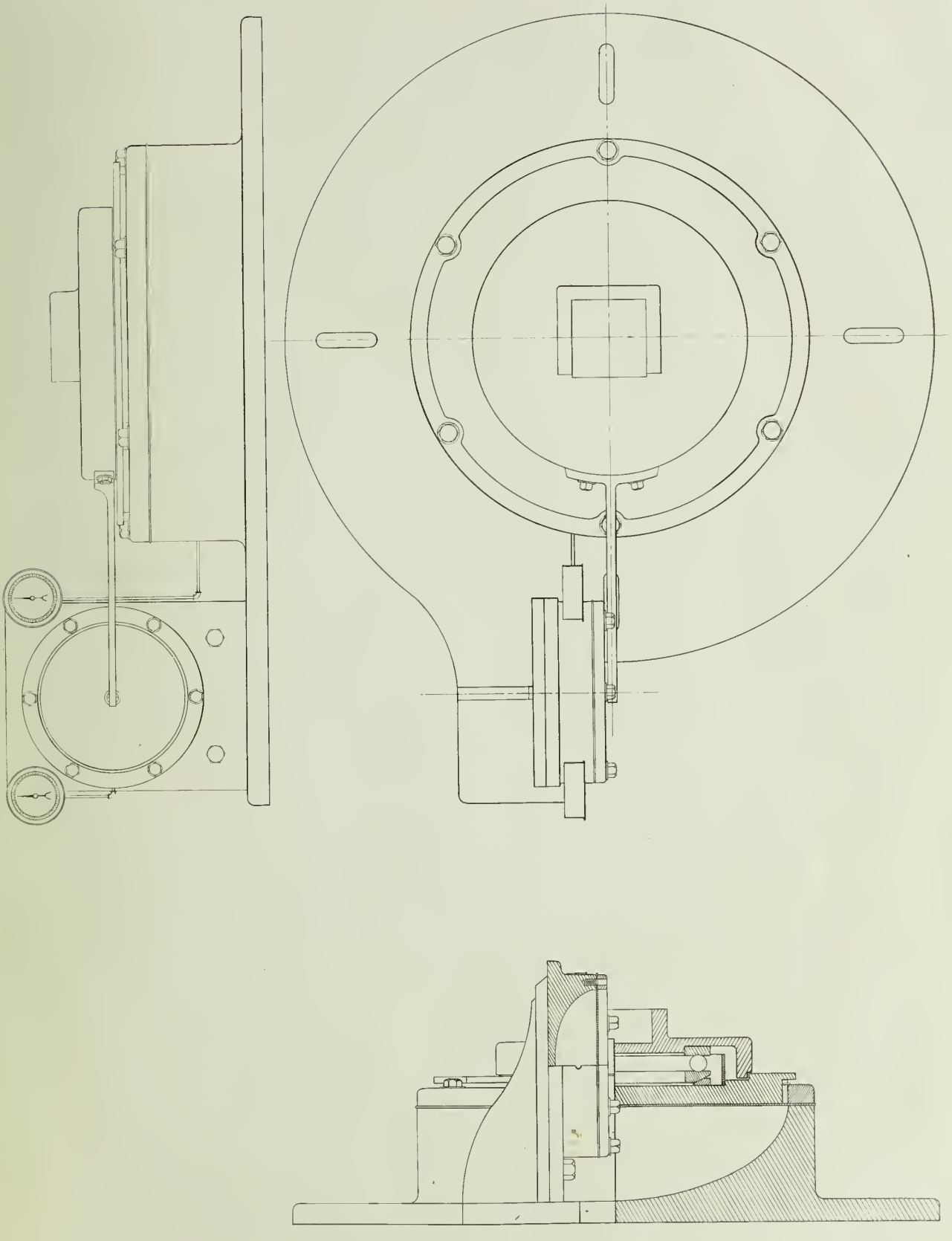
5. Errors. In conducting a series of tests of this nature there is an extreme liability that errors will be made, due both to the apparatus used and to the material upon which the tests are being made. The errors due to the machine would be caused by friction in the parts, leakage, or by unproportional compression of the fluid in the compression chambers. By the use of a bearing of finest grade obtainable, the chance of error due to friction is rendered very slight. By using a light oil instead of air or other gas in the reservoirs, the chance of error due to leakage is also reduced to a minimum. Should there be any leakage, however, the resulting error must necessarily be small with the design that has been followed, since it would vary as the ratio of the squares of diameter of the reservoir from which the leak takes place to that of the gauge tube or manometer bore.

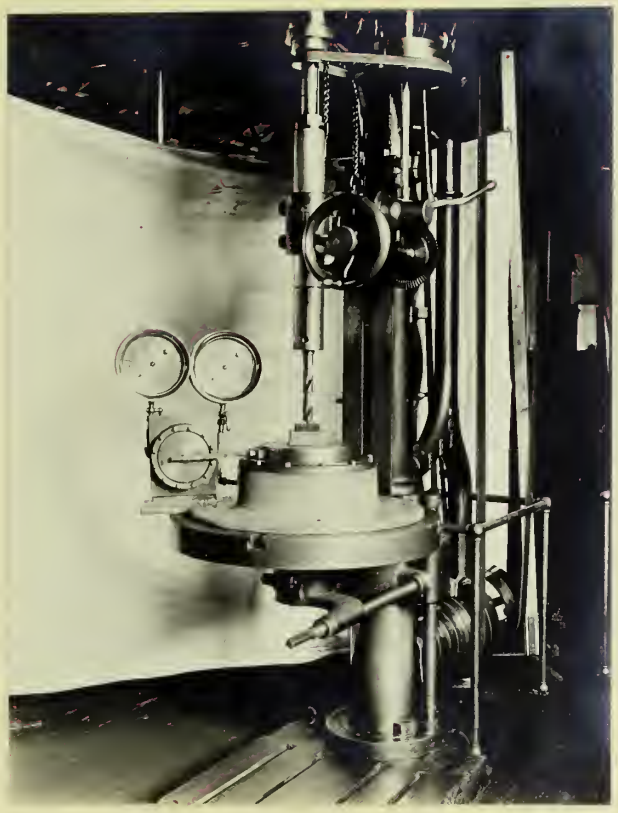
Care must be taken when filling the reservoirs to see that the air is completely expelled, also that the pipes leading to the gauges are filled above the level of the diaphragm, that a slight outward pressure may be exerted on them.

6. Range of Experiments. The machine is adaptable to a wide range of experiment. The hub is provided with a receptacle and clamp for holding material of a standard cross section; however, the depth of cut is limited only by the length of drill. Tests may be made to determine the proper angle for sharpening to produce the best results in drilling different kinds of metals, also the proper speed and feed, and the effect of different lubricants and cutting compounds.

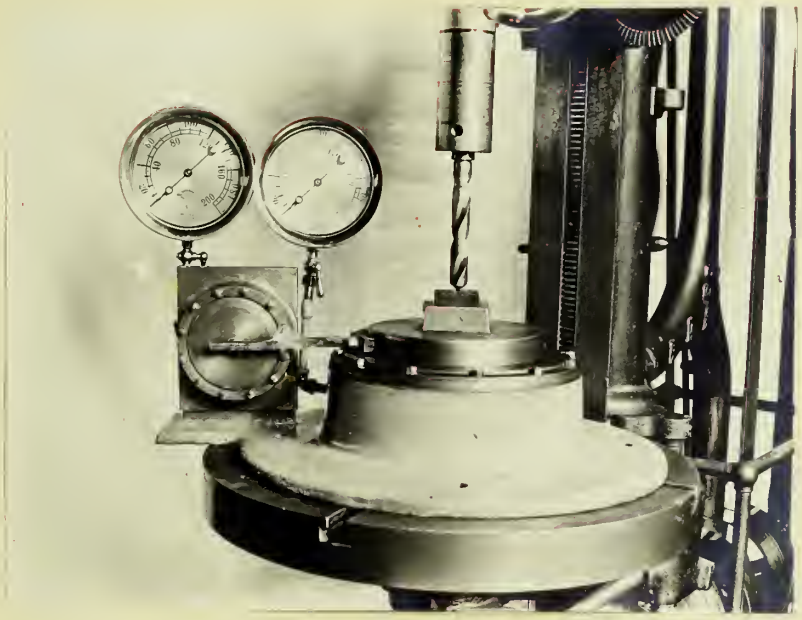
The accompanying photograph shows a view of the apparatus under working conditions.


Tap for ¼" C.S.
Drill ¼" Holes
Drill 13/32" Holes
Tap for ⅜" C.S.
10"
12"





View of dynamometer under working conditions.



View of details of dynamometer.

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